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MORPHOLOGICAL CHANGES IN ANIMAL VISCERA DURING INHALATION OF LOW CONCENTRATIONS OF ARSENIC TRIOXIDE

[Morfologicheskiye izmeneniya vo vnutrennikh organakh zhivotnykh pri ingalyatsionnom vozdeystvii nizkikh kontsentratsii mysh'yakovistogo angidrida]

By

C.K. Bikmullina, E.N. Panycheva and I.S. Rozenshteyn,
Sverdlovsk Medical Institute, Sverdlovsk Institute of Occupational Hygiene

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When ores of nonferrous metals are roasted and melted, and when coal is burned, the arsenic in the raw material is oxidized to arsenic trioxide, which is expelled into the atmosphere along with industrial gases. The actual concentrations of arsenic trioxide in air downwind from industrial plants, according to the figures of a number of authors, were found to be comparatively low -- from 0.4 to 97 $\mu g/m^3$ (F.I. Dubrovskaya and D.P. Siderikhina, 1958; B.P. Gurinov, 1955; N.S. Pakhotina, 1964). However, even low concentrations of harmful substances in the atmosphere can be dangerous with prolonged, round-the-clock exposure.

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The chronic effects of arsenic trioxide have been studied essentially for oral routes of administration. In this case, functional and pathomorphological changes have been observed in the central nervous system and internal organs (K.I. Akulov, 1955; M.S. Tolgskaya, 1957; F.M. Gorskaya, 1957). However, the toxicological significance of low concentrations of arsenic trioxide in the atmosphere has not been sufficiently discussed in the literature.

In order to discover the hygienic and toxicological characteristics of low concentrations of arsenic trioxide, such as those observed in the atmosphere, we tested the effects on white rats of round-the-clock inhalation of low concentrations of arsenic trioxide for a period of 3 months. Three concentrations were employed in the experiment:

60.7 ± 0.8 $\mu g/m^3$ -- first group of animals;

4.9 ± 0.13 $\mu g/m^3$ -- second group of animals;

1.3 ± 0.08 $\mu g/m^3$ -- third group of animals;

The fourth group of animals was a control group.

In the course of the experiment, it was found that there were functional shifts in the central nervous systems of animals in the first and second groups. These shifts are of the inhibition type, lowering the concentration of sulfhydryl groups in the blood, suppressing the activity of some enzymes (cholinesterases, pyrovate [sic] oxidases). At the end of the experiment, accumulation of arsenic in the viscera was discovered. In the animals of the third group, neither functional nor biochemical changes were found on the basis of the test.

The pathomorphological investigations of the viscera of animals exposed to different concentrations of arsenic trioxide were carried out at the end of the 3-month exposure period.

The cerebra of animals exposed to 60.7 $\mu g/m^3$ arsenic trioxide exhibited pronounced pericellular edema, perivascular cellular infiltrations from histiocytic and lymphoid elements, and also plasmatic imbibition in the walls of blood vessels and local hemorrhages. In the layer of the central pyramid, together with corrugation of the cells, the cytoplasm of which was stained hyperchromically, plasmolysis and karyolysis were observed.

In the bronchi of the animals of this group, we found accumulation of leukocytic exudate, edematous peribronchial tissue, hyperplasia of lympoid follicles with admixture of plasmatic cells. The alveoli were expanded as in emphysema, some of them containing serous-leukocytic exudate. Along with these manifestations, we encountered regions with thickened interalveolar walls due to cellular infiltration of segment-nuclear leukocytes and lymphoid and histiocytic elements. The walls of the blood vessels were thickened as a consequence of plasmatic imbibition, "plasmorrhage" also being observed.

In the liver, adipose dystrophy, polymorphism, and amitotic cell division were found. The spleens exhibited hyperplasia of lympoid follicles and plasmatic imbibition of vessel walls. Visible in the renal parenchyma were local hemorrhage and epithelial granules.

Plasmolysis and karyolysis of nerve cells was not observed in animals of the second group, which had been exposed to arsenic trioxide in a concentration of 4.9 $\mu g/m^3$. The remaining pathomorphological changes in the viscera were identical with those described above, but less pronounced.

The histomorphological picture of the internal organs of animals exposed to 1.3 $\mu g/m^3$ arsenic trioxide did not differ from that of the control group.

Conclusions

1. Prolonged round-the-clock exposure of white rats to arsenic trioxide in concentrations of 60.7 and 4.9 $\mu g/m^3$ results in degenerative-dystrophic changes in the cerebrum, lungs, liver, kidneys, and gastrointestinal tract.

2. Under these conditions, a concentration of 1.3 $\mu g/m^3$ arsenic trioxide did not induce pathomorphological changes in the viscera of the experimental animals.

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